

YAMASAKI ET AL. - 10/673,648  
Client/Matter: 071469-0305916

### REMARKS

Claims 1-54 are pending. By this Amendment, claim 26 is amended. Claims 41-54 are withdrawn from consideration as drawn to a non-elected invention, the requirement having been traversed in the response filed July 30, 2004. Reconsideration and allowance based on the above amendments and following remarks is respectfully requested.

Claims 1-40 were rejected under 35 U.S.C. § 103(a) over Locke et al. (U.S. Patent 6,630,330) in view of Yoon et al. (U.S. Patent 6,827,978). The rejection is respectfully traversed.

Claim 1 recites a method of depositing a metal layer on a semiconductor substrate, including providing a substrate in a process chamber; introducing a process gas in the process chamber, the process gas comprising a metal-carbonyl precursor gas and at least one of a dilution gas and a carrier gas, wherein the ratio of the metal-carbonyl precursor gas flow rate and the process gas flow rate is less than about 0.15; and depositing a metal layer on the substrate by a thermal chemical vapor deposition process.

Claim 22 recites a method of depositing a W layer including providing a substrate in a process chamber; flowing a process gas in the process chamber, the process gas comprising a  $W(CO)_6$  precursor gas and at least one of a dilution gas and a carrier gas, wherein the ratio of the  $W(CO)_6$  precursor gas flow rate and the process gas flow rate is less than about 0.15; and depositing a W layer on the substrate by a thermal chemical vapor deposition process.

The Examiner acknowledges on page 5, lines 7-10, of the Office Action that Locke et al. do not disclose or suggest that the the ratio of the metal-carbonyl precursor gas flow rate and the process gas flow rate is less than about 0.15. The Examiner alleges, however, that Yoon et al. disclose this feature in column 10, lines 55-58, and concludes, on page 6, lines 1-5 of the Office Action, that it would have been obvious to have modified Locke et al. by the teachings of Yoon et al. to result in enhanced morphology as described in column 1, lines 25-31 of Yoon et al.

MPEP § 2143 states: "To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations."

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It is respectfully submitted that the combination of Locke et al. and Yoon et al. fails to establish a *prima facie* case of obviousness because the combination fails to include all the limitations of claims 1 and 22 and because there is no motivation or suggestion to combine the references' teachings.

Column 10, lines 55-58, of Yoon et al. disclose the formation of tungsten nucleation layers formed by sequentially adsorbing monolayers of tungsten hexafluoride ( $WF_6$ ) and monolayers of diborane ( $B_2H_6$ ) at specified flow rates of the tungsten hexafluoride and a carrier gas comprising argon. It is respectfully noted, however, that tungsten hexafluoride is not a metal-carbonyl precursor gas, as recited in claim 1, nor a  $W(CO)_6$  precursor gas, as recited in claim 22. It is respectfully further noted that Yoon et al. provides no example, disclosures or suggestions of flow rates for metal-carbonyl precursor gases or  $W(CO)_6$  precursor gases. All of the disclosure and samples provided by Yoon et al. relate to tungsten hexafluoride, which is not a metal-carbonyl precursor gas. Accordingly, even assuming it would have been obvious to combine the teachings of Locke et al. and Yoon et al., such a combination would not include all the limitations of claims 1 and 22 and would not present a *prima facie* case of obviousness.

It is further respectfully submitted that there is no motivation or suggestion, either in Locke et al. or Yoon et al., or in the knowledge generally available to one of ordinary skill in the art to combine the references' teachings. As disclosed, for example, in paragraph [0030] of the instant application, incorporation of CO into a metal layer during deposition may lead to surface roughness in the metal layer and increased resistivity. As Yoon et al. disclose only the ratios of tungsten hexafluoride ( $WF_6$ ) necessary for the formation of metal layers, one of ordinary skill in the art would not have looked to the disclosure of Yoon et al. to solve the problem of incorporation of CO into the metal layer using metal-carbonyl precursor gas during deposition, as the use of tungsten hexafluoride would not result in incorporation of CO during deposition.

Claims 2-21 and 23-40 recite additional features of the invention and are allowable for the reasons discussed above with respect to claims 1 and 22, respectively, and for the additional features recited therein.

Reconsideration and withdrawal of the rejection of claims 1-40 are respectfully requested.

Claim 41 recites a processing system for depositing a metal layer on a semiconductor substrate including a process chamber; a substrate holder for receiving a substrate; a heater

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for heating the substrate; a precursor delivery system for flowing a process gas in the process chamber, the process gas comprising a metal-carbonyl precursor gas and at least one of a dilution gas and a carrier gas, wherein the ratio of the metal-carbonyl precursor gas flow rate and the process gas flow rate is less than about 0.15; and a controller for controlling the processing system.

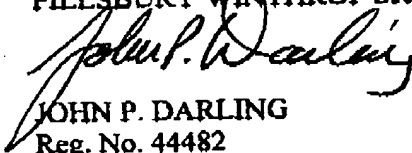
As discussed above, there is no disclosure or suggestion by either Locke et al. or Yoon et al. of the ratio recited in claim 41 and the combination fails to present a prima facie case of obviousness. Accordingly, Applicants respectfully request rejoinder of claims 41-54 and allowance of these claims.

In view of the above amendments and remarks, it is respectfully submitted that all of the claims are allowable and the entire application is in condition for allowance.

Should the Examiner believe that anything further is desirable to place the application in better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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